Aalto University
School of Business

UNCONVENTIONAL MONETARY POLICY

A Theoretical Perspective

Bachelor's Thesis
Joonas Kotiranta
Aalto University School of Business
Economics
Spring 2020

Aalto University
School of Business

Aalto University, P.O. BOX 11000, 00076 AALTO
www.aalto.fi

Abstract of bachelor's thesis

Author Joonas Kotiranta

Title of thesis Unconventional Monetary Policy: A Theoretical Perspective

Degree Bachelor's degree

Degree programme Economics

Thesis advisor(s) Pauli Murto, Mikko Mustonen

Year of approval 2020 **Number of pages** 16 **Language** English

Abstract

This paper is a literature review that studies a model of credit policy conducted by the central bank. In this paper, the model is explained and, using the model, the effectiveness of credit policy is analysed in different scenarios with similarities to the scenario of the 2008 financial crisis. It is shown that credit policy can have a significant positive impact on key aspects of an economy, such as output and inflation, especially when the zero lower bound limit of conventional monetary policy is binding, but even when the limit is not binding. The effects of credit policy can thus help an economy recover from the recession.

Keywords unconventional, monetary, policy

Table of Contents

1. Introduction

In recent history, interest rate policy has widely been the most important measure that central banks have used to conduct monetary policy in order to keep interest rates low and stimulate economic growth. However, in the recent two decades there has been increasing discussion about alternative methods of conducting monetary policy besides interest rate policy, which are collectively referred to as unconventional monetary policy. This discussion has become relevant in today's economic landscape because of two major factors: the recent global economic recession caused by the 2008 financial crisis and nominal interest rates approaching the zero lower bound limit.

The nominal interest rate policy that central banks use is determined using a wide variety of macroeconomic signals, all of which the central banks do not necessarily disclose, but it can be approximated using the Taylor rule. The Taylor rule approximates interest rate policy to rely on two factors: inflation and the output gap (i.e. the difference between an economy's output and its potential output). As the output gap increases during a recession, meaning that gross domestic product (GDP) growth becomes smaller than the potential GDP growth of an economy, the Taylor rule states that the target interest rates of central banks will go down. This is in of itself not an issue, but when paired with the zero lower bound problems start to arise.

The zero lower bound refers to the fact that in practice target nominal interest rates set by central banks are effectively constrained to zero (or very closer to it). The interest rates are constrained to zero because if interest rates would fall below zero, cash would become a viable investment. This could cause a crash in the demand for financial assets such as stocks and bonds and fire-sales of these financial assets, causing a variety of problems for the financial market and the whole economy. The severity of the recession caused by the 2008 financial crisis has caused the zero lower bound limit to become constraining, meaning that the Taylor rule would suggest lowering nominal interest rates below zero.

Another noteworthy aspect of the 2008 financial crisis was the major frictions that sprung up in the financial sector. The liquidity problems that financial intermediaries, or banks, faced caused by the burst of the housing market bubble combined with the uncertainty brought by the collapse of Lehman Brothers resulted in the whole financial market effectively coming to a standstill. The standstill and the frictions it caused in the financial sector resulted in a decrease in the effectiveness of conventional monetary policy, as the premium that financial intermediaries charge increased due to the uncertainty and risk in the market, meaning that the transmission mechanism of interest rate policy practiced by the central bank is broken. As we will see later, this increase in friction also increases the effectiveness of unconventional monetary policy.

These reasons have caused conventional monetary policy to become an inadequate measure in order to conduct successful monetary policy in crisis situations, and major central banks such as the Federal Reserve of the United States of America and the European Central Bank have implemented monetary policy that is considered unconventional after the 2008 financial crisis. Perhaps the most important form of unconventional monetary policy implemented by these two central banks, and the one that this paper will focus on, is the central bank's balance sheet expansion as a form of monetary policy. This is commonly referred to as credit policy, credit easing or most commonly as quantitative easing.

The terms credit easing and quantitative easing technically mean different things although they have similar goals: credit easing means that the central bank buys assets from the private sector such as corporate bonds, while quantitative easing means that the central bank buys government bond or other long term assets (Investopedia). In this paper, the term credit policy will be used as an umbrella term for both quantitative easing and credit easing. This is because within the model used in this paper, the two have identical effects. This will be explained in more detail in section 2.7.

This paper will examine the situations where credit policy can be an effective tool for conducting monetary policy, and discuss whether credit easing could be implemented alongside traditional interest rate policy in a normal economic situation, or whether it should be used merely as an unconventional monetary policy in unconventional economic situations such as the post 2008 period. This will be done by approaching this question using macroeconomic models that simulate the effect that credit policy practiced by central banks can have on an economy. The primary model used in the analysis is a model created by Gertler and Karadi (2011).

This paper will first introduce the model created by Gertler and Karadi (2011) which will be used for the analysis. Some results obtained from this model will then be discussed, and it is shown that credit policy conducted by the central bank can have a significant impact on the recovery of an economy from a crisis, such as the one witnessed in 2008.

2. The model

The model that will be used for the analysis done in this paper is a dynamic stochastic general equilibrium model (DSGE) based on models developed by Christiano, Eichenbaum and Evans (2005) and Smets and Wouters (2007). These models have been developed further by Gertler and Karadi (2011), who added financial intermediaries that transfer funds between households and firms and an exogenous shock in the quality of capital. This shock in capital quality is meant to represent a sudden shock in asset prices such as the shock in mortgage-backed securities prices that triggered the 2008 financial crisis. These additions are meant to create a model that can better capture the conditions of the 2008 financial crisis, where distrust in the financial sector created very notable frictions in the sector. When the financial sector is not working as efficiently as usual, this degrades the effectiveness of conventional monetary policy as the transmission mechanism of interest policy relies on a functioning financial sector. This is why the additions to the base models made by Gertler and Karadi are important, since these base models are unable to properly capture the situation during the 2008 crisis.

The model has five different agents, which are discussed in sections 2.1 through 2.5. It also has a central bank that conducts both regular monetary policy, which is discussed in section 2.6, and credit policy, which is discussed in section 2.7.

2.1 Households

Households in the model are identical. Households supply labor, for which they earn income. This income is either consumed or saved. Households can save by lending funds to financial intermediaries, so keeping their money in a bank account, or by lending funds to the government.

Household members can be either bankers or any other type of workers, which will collectively be referred to as simply workers. Each banker manages a financial intermediary and transfers income to the household, meaning that households own the financial intermediaries that their bankers manage. Workers supply all kinds of

other labor and also transfer income to the household. Household savings are deposited into intermediaries that the household does not own. This is important for the formation of the agency problem discussed in the next section.

Within a household there is perfect consumption insurance, meaning that the households consume and save in such a way that their utility gained from consumption stays constant over time. Additionally, the households act rationally in this model, meaning that they will maximize their utility within the constraints of their budget.

2.2 Financial intermediaries

Financial intermediaries lend funds that they received from households to non-financial firms. The financial intermediaries of this model consist of the whole banking sector, meaning that investment banks and commercial banks are both included in this category.

Let us denote the amount of wealth or net worth of an intermediary j at the end of period j as N_{jt}, the deposits the intermediary holds as B_{jt}, the quantity of financial claims the intermediary has collected by loaning money to non-financial firms as S_{jt} and the relative price of each claim as Q_t. Then the intermediary balance sheet is given by:

$$Q_t S_{jt} = N_{jt} + B_{jt} \tag{1}$$

The right side of the equation is the intermediaries equity and liabilities and the left side is its assets. The deposits B_{jt} earn a return of R_{t+1} and the financial claims S_{jt} earn a return of R_{kt+1} at $t+1$. This means that over time, the development of the intermediaries net worth if given by:

$$N_{jt+1} = (R_{kt+1} - R_{t+1}) Q_t S_{jt} + R_{t+1} N_{jt} \tag{2}$$

So growth in the intermediaries net worth depends on the premium it charges $(R_{kt+1} - R_{t+1})$ and the amount of assets it holds $Q_t S_{jt}$. As the intermediary will attempt to increase its net worth, it is beneficial for the banker to increase the size

of its assets. This holds when the risk adjusted return of the intermediary is greater than or equal to what the household can earn on its deposits, since if the risk adjusted return of the intermediary is smaller than what households can earn on deposits the intermediary could earn more by loaning all of its assets to another intermediary.

To remove a limitless expansion of an intermediaries assets, the model introduces an agency problem. The banker who manages the financial intermediary can divert a fraction of the intermediaries assets to their household, and the depositors cannot get these funds back. The risk for the banker is that its depositors can force the intermediary into bankruptcy. So for lenders to be willing to deposit money in the intermediary, the cost caused to the banker by the closing the intermediary must be higher than the gain the banker receives from the diverted assets. This incentive constraint for lenders can be expressed by:

$$\eta_t N_{jt} + \upsilon_t Q_t S_{jt} \geq \lambda Q_t S_{jt} \tag{3}$$

where λ is the amount of funds diverted, η_t is the expected discounted value of having another unit of N_{jt} while holding S_{jt} constant and $\upsilon_t$is the expected discounted marginal gain to the banker for expanding its assets ($Q_t S_{jt}$) by a unit. So the left side is the cost for the banker to divert λ amount of funds and the right side is the benefit for the banker to do this.

This agency problem creates a scenario where financial intermediaries cannot increase their assets indefinitely because households will not be willing to deposit funds to an intermediary indefinitely due to the increased risk of their funds being diverted by the bank into the bankers own household. When the constraint in equation (3) is binding, the assets an intermediary can acquire is given by:

$$Q_t S_{jt} = \frac{\eta_t}{\lambda - \upsilon_t} N_{jt} = \phi_t N_{jt} \tag{4}$$

where ϕ_t is the ratio of intermediated assets to equity, or leverage ratio, meaning that an intermediaries ability to acquire assets is bound by its leverage ratio.

2.3 Intermediate goods firms

Intermediate goods firms are firms that produce goods which are then sold to retail firms. These firms use capital to produce their goods and they finance their capital purchases by borrowing funds from financial intermediaries, and this capital can be sold during later periods. In this model there are no frictions in the market between intermediate goods firms and financial intermediaries, meaning that a firm's ability to acquire funds is constrained only by the supply of funds that financial intermediaries have. This also means that intermediate goods firms earn zero profits, as a frictionless market means that financial intermediaries have perfect information on the firms so they can price their loans in such a way that the firms make zero profits, maximizing the intermediaries profits.

An intermediate firms production function is the following:

$$Y_t = A_t(U_t \xi_t K_t)^{\alpha} L_t^{1-\alpha} \tag{5}$$

where Y_t is output, A_t is total factor productivity, U_t is the utilization rate of capital, ξ_t is the quality of capital, K_t is capital and L_t is labor. ξ_t represents an exogenous variation in the value of capital. Since firms can sell their capital at later periods a variation ξ_t will affect a firms return to capital, which in turn will affect the earnings of financial intermediaries.

2.4 Capital producing firms

Capital producing firms build new capital which they sell to intermediate goods firms. Capital producing firms also buy capital from intermediate goods firms, repair the depreciated capital and sell the repaired capital. Capital producing firms can make non-zero profits and they are owned by households, so any profits made are channeled into households.

2.5 Retail firms

Retail firms sell goods that intermediate goods firms produced. The retailers do not have any marginal costs except the price of the goods charged by the intermediate

firms. Retail firms can adjust prices freely to maximize profits. They can also index their prices to the lagged inflation rate.

2.6 Conventional monetary policy

In the model, there is a central bank that uses conventional monetary policy to achieve its goals. The monetary policy the central bank uses is determined by a Taylor rule with interest rate smoothing:

$$i_t = (1-\rho)\left[i + \kappa_\pi \pi_t + \kappa_y(\log Y_t^* - \log Y_t)\right] + \rho i_{t-1} + \epsilon_t \quad (6)$$

where i_t is the nominal interest rate, i is the steady state nominal interest rate, Y_t^* is the natural level of output, ρ is the interest rate smoothing parameter, ϵ_t is the exogenous shock to monetary policy and κ_π and κ_y are the inflation and output gap coefficients respectively.

2.7 Credit policy

In this model, the central bank conducts credit policy by issuing government debt to households. This government debt pays the riskless rate R_{t+1} as it is assumed that governments will pay back their debts. This also means that the government is not constrained by its balance sheet on how much debt it can issue, since there is no agency conflict. The households lend the funds to non-financial firms with the interest rate R_{kt+1}. There is an efficiency loss involved in this process, and it can be thought of as the cost of the government issuing the debt.

Another equivalent way the central bank could conduct credit policy is by using financial intermediaries to channel funds to non-financial borrowers. Here it is assumed that the borrowers cannot neglect their debt, so again the borrowers balance sheet constraints do not limit their ability to receive this credit policy aid. The central bank lends funds to financial intermediaries with an interest rate of R_{kt+1} and the financial intermediaries lend the money on to non-financial firms at the same rate. This means that the financial intermediaries do not make a profit from the credit central bank funds. Again there is an efficiency cost equal to that in the first credit

policy method. This time it can be thought of as the cost of channeling funds to financial intermediaries.

The first method of credit policy is referred to as credit easing and the second is quantitative easing. As they have identical effects, in this paper they are jointly referred to as credit policy. The main mechanism that they affect inflation and the output of an economy is through the credit spread $R_{kt} - R_t$, since it increases liquidity and certainty in the economy, aiding investing.

The central bank determines the amount of credit to be injected into the economy according to equation 7:

$$\psi_t = \psi + \upsilon[(R_{kt+1} - R_{t+1}) - R_k - R] \tag{7}$$

where ψ is the steady state fraction of publicly intermediated assets, i.e. the steady state amount of credit policy, $R_k - R$ is the steady state interest rate premium and υ can be thought of as an intensity parameter (that is always positive) which measures the intensity of the credit intervention. Additionally, during a crisis when credit policy needed, the central bank drops the credit smoothing of interest rates, so its sets the parameter ρ in the Taylor rule to zero.

3. Analysis

Using the model introduced above, Gertler and Karadi (2011) conduct a series of experiments to determine the effectiveness of unconventional monetary policy in different scenarios. In each experiment, the initial disturbance to the model is a decline in capital quality, which results in a severe reduction in the value of assets held by financial intermediaries. This disturbance was chosen because it roughly simulates the scenario of the 2008 financial crisis and the size of the shock in capital quality is set so that it results in a recession roughly of the same size as the 2008 financial crisis. In each figure in the following sub-chapters there are multiple graphs that show how different variables behave in each scenario. The Y axis of each graph shows the percentage change of the variable in question and the X axis shows time measured in months, where zero marks the initial shock. In the figures, pi represents inflation, i represents nominal interest rates, R^k-R represents the premium charged by financial intermediaries, Y represents output, C represents consumption and I represents investment.

3.1 Experiment without credit policy

The first experiment considers a scenario where the central bank does not implement any credit policy measures, and the results of this experiment are shown in Figure 1. In the figure SDGE refers to the base model developed by Christiano, Eichenbaum and Evans (2005) and Smets and Wouters (2007) that does not contain financial frictions. FA refers to the financial accelerator model which is the model that has the improvements made by Gerteler and Karadi (2011), meaning that frictions do exist in the financial market.

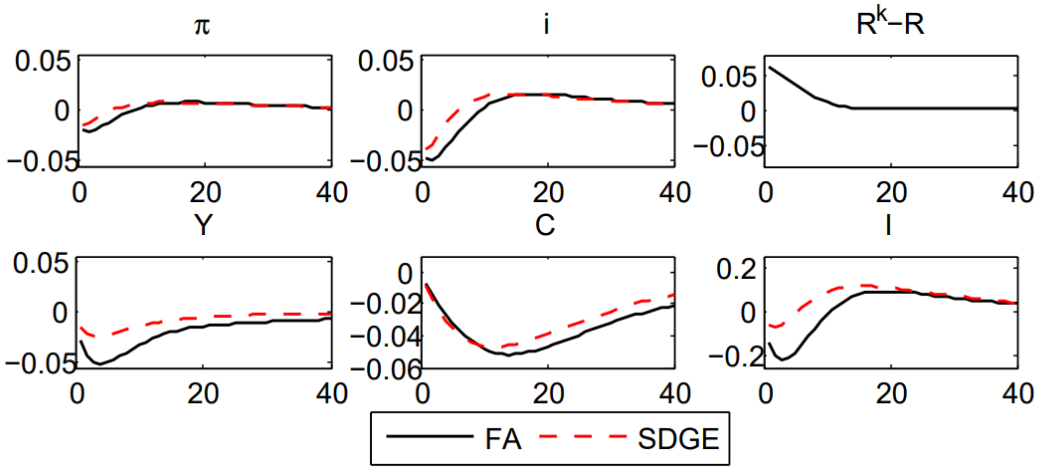

Figure 1: experiment without credit policy

We can see that output, consumption and investment all fall, and the central bank drops the nominal interest rate as a response. It is also important to notice that all these reactions are more severe in the model that contains financial frictions. The reason of this is that that the premium charged by financial intermediaries for loans they issue ($R^k - R$) increases sharply in the model which contains financial frictions. Naturally, in a model with no financial frictions this ratio stays at a constant 0, so it is not drawn in Figure 1.

When the premium $R^k - R$ increases, this results in a second dip in investment after the initial one, which results in another reduction in output Thus output falls so much more in the model where financial frictions are included. This experiment illustrates well how significant of a difference this small distinction of friction in the financial market makes. Real-world financial markets do of course have frictions, and this same spike in premiums charged by financial intermediaries can be observed for instance in the European Interbank Offered Rate (EURIBOR) for the time period between early August and mid-October in 2008.

3.2 Experiment with credit policy

This experiment considers a scenario like the one above, but with one key difference being that the central bank conducts credit policy. The results are shown in Figure 2

(in the figure the υ parameter is the parameter introduced in section 2.3: in short it determines the intensity of credit policy).

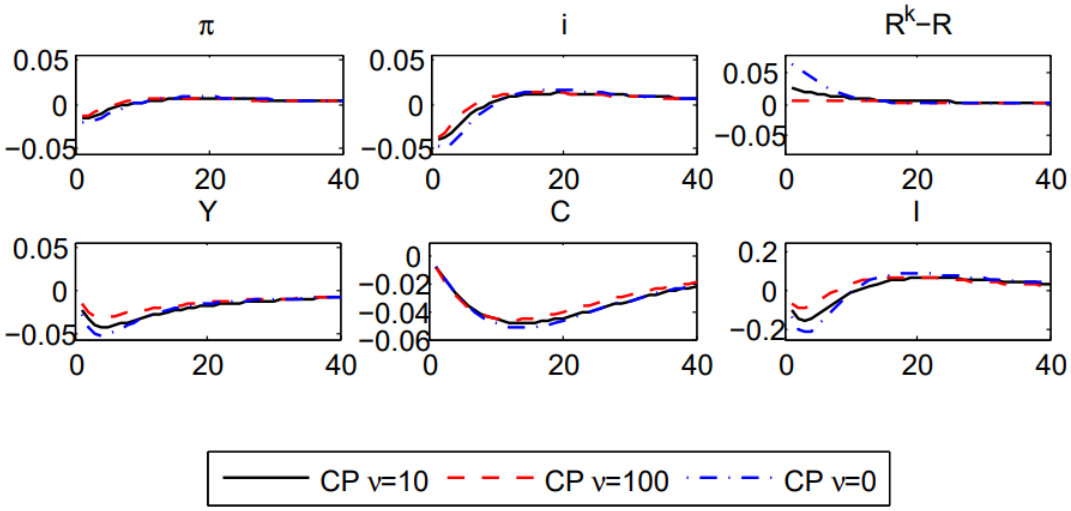

Figure 2: experiment with credit policy

From Figure 2, we see that credit policy does alleviate the recession caused by the shock in capital quality, as output, consumption and investment all decrease less when credit policy is introduced ($\upsilon \neq 0$). However, the effect of credit policy is not very large. We can also see that the more aggressive credit policy ($\upsilon = 100$) has a larger positive effect compared to the moderately aggressive credit policy ($\upsilon = 10$).

The most important mechanism through which credit policy achieves this result is credit spread ($R^k - R$). The increase in credit spread is reduced significantly in the case of the moderately aggressive credit policy, and even more with aggressive credit policy. This results in a smaller decrease in investment, which results in a smaller decrease in output.

Another noteworthy point is that inflation does not increase by much as a result of the credit easing operations, which can be seen in Figure 2, as this might be a concern for central banks who are considering implementing credit policy.

3.3 Experiment with credit policy and zero lower bound

The final experiment considers a scenario with a similar shock in capital quality and a credit policy response from the central bank, but this time the zero lower bound limit for nominal interest rate is enforced. As we can see from Figure 2, the Taylor rule used in the model suggests that nominal interest rates should be dropped well below zero since the steady state nominal interest rate in the model is 400 basis points and the interest rate in Figure 2 falls by more than 500 basis points. This is not a realistic response, as it will cause a multitude of problems. Even though nominal interest rates have violated the zero lower bound in major economies since the 2008 crisis, these violations have been much smaller and it is unrealistic if not outright impossible to drop nominal interest rate as much as Figure 2 suggests. Therefore, imposing the zero lower bound restriction on this model can provide valuable information.

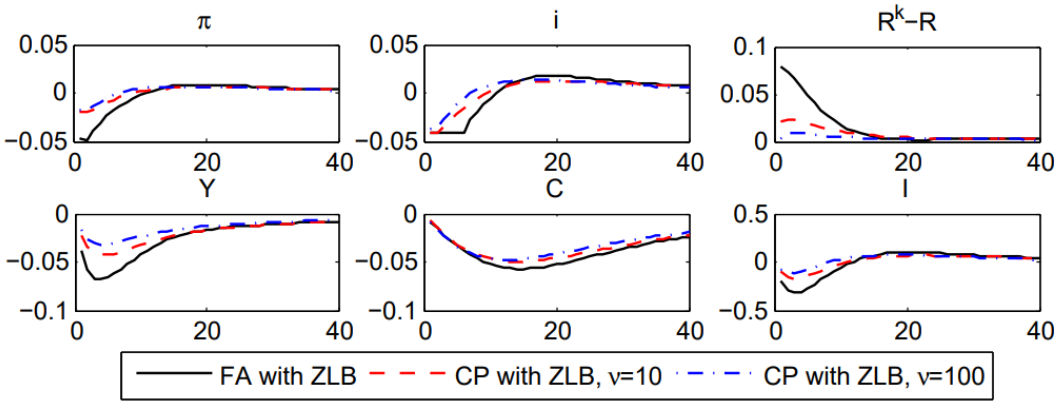

Figure 3: experiment with credit policy and zero lower bound

The effects of imposing the zero lower bound on the model can be seen in Figure 3, and it is clear that the effect of the crisis on output is much more severe than when zero lower bound is not imposed and credit policy is not used. Here we also see where credit policy gets to shine, as the same credit policy measures have a much more significant effect when compared to the scenario where zero lower bound was not imposed. The transmission mechanism is the same as before, so the most important result of credit policy is that the credit spread $R^k - R$ increases less with credit policy, which boosts investing and output.

Another noteworthy observation from this experiment is what happens to inflation. In Figure 3, we see that in the case of no credit policy a severe case of deflation occurs, which would be very damaging to the economy. The credit policy measures significantly alleviate this deflationary pressure. This result indicates that credit policy in crisis situations where zero lower bound needs to be imposed not only could provide a significant increase in output of the economy, but it could also prevent deflation occurring.

3.4 Opposing views on credit policy

There are arguments to be made against the effectiveness of credit policy. For example Eggertsson and Woodford (2003) argue that the private sector, represented by a single agent that has no balance sheet constraints that affect their ability to obtain credit and has an infinite time horizon, sees government and central bank assets equivalently as their own assets, meaning that the swapping of assets involved in credit policy accomplishes nothing. While this might theoretically be true, it faces similar criticism as the Ricardian equivalence, which states that increased debt-financed government spending to stimulate the economy cannot be effective because the public sector will save in anticipation of future tax increases, thus having no real impact on the output of an economy. Both of these propositions are very theoretical, and there is little empirical evidence to support them. For instance Joycem Miles, Scott and Vayanos (2012) point out that the representative agent assumption made by Eggertsson and Woodford (2003) is a strong assumption. Additionally, they note that the assumption of perfect asset substitution is also strong assumption even in unstressed financial markets, and even more so in stressed financial markets which are typical to crisis situations.

Conclusion

According to the model developed by Gertler and Karadi, credit policy can have a significant effect on an economy. It can help an economy recover from a recession even when nominal interest rate have not reached zero lower bond. If nominal interest rates have reached the zero lower bound the effects and significance of credit policy is increased significantly since conventional monetary policy is not enough to mitigate the effects of the recession.

The main channel for credit policy to take affect is by reducing the premium $R^k - R$ that financial intermediaries charge. When the premium is reduced, investment in the economy will increase as investing is made cheaper. As investment increases, the output of the economy increases, reducing the severity of the recession.

There are counter arguments to be made against the effectiveness of credit policy. Some researchers point out that under certain condition, the asset swaps of credit policy should have no effects on real economic indicators. These ideas have however faced similar criticism as Ricardian equivalence: for credit policy to be ineffective, strong and perhaps unrealistic assumptions for the real world have to be made.

This paper demonstrates the importance of credit policy during a crisis situation and why it is important for central bank to implement credit policy as a countermeasure for the crisis. The model and ideas discussed in this paper have real-world implications that are useful to central banks during crisis times such as the 2008 financial crisis.

References

Bernanke, B. and Reinhart, V. 2004. “Conducting monetary policy at very low short-term interest rates.” American Economic Review 94, 85-90

Christiano, L, M Eichenbaum and C Evans. 2005. “Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy.” Journal of Political Economy 113, 1-45

Curdia, V. and Woodford, M. 2009. “Conventional and unconventional monetary policy.” FRB of New York Staff Report 404

Curdia, V. and Woodford, M. 2011. “The central-bank balance sheet as an instrument of policy.” Journal of Monetary Economics 58, 54-79

Eggertsson, G. and Woodford, M. 2003. “The zero bound on interest rates and optimal monetary policy.” Brookings Papers on Economic Activity, 139-233

M Gertler, P Karadi. 2011. “A model of unconventional monetary policy.” Journal of monetary Economics 58, 17-34

Joyce, M, D Miles, A Scott and D Vayanos. 2012. “Quantitative Easing and Unconventional Monetary Policy – an Introduction.” The Economic Journal 122, 271-288

Krishnamurthy, A. and Vissing-Jorgensen, A. 2011. “The effects of quantitative easing on interest rates: channels and implications for policy” Brookings Papers on Economic Activity, 215+

Smets, T. and Wouters, R. 2007. “Shocks and Frictions in U.S. Business Cycles: A Bayesian DSGE Approach.” American Economic Review 97, 586-606